Treatment for Giant Aneurysms in the Cavernous Portion of the Internal Carotid Artery using Detachable Coils

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Summary

We report 7 patients with symptomatic giant aneurysms in the cavernous portion of the internal carotid artery (ICA) who were treated by trapping the ICA on either side of the aneurysmal orifice using detachable coils. In all 7 patients the ICA was sacrificed; 5 patients subsequently underwent bypass surgery (STA-MCA bypass, n = 4; high-flow bypass, n = 1), the other 2 patients did not. In 6 patients, there were no post-treatment embolic episodes; one patient who had been treated by proximal occlusion of the ICA developed transient ischemia due to an intra-aneurysmal thrombus. Cranial nerve palsies were markedly improved in all patients.

ICA trapping using detachable coils was a highly successful treatment method in these patients. We found the detachable coils effective and easy to use in the trapping methods applied in this series of 7 patients.

Introduction

The mass effect attendant to giant aneurysms arising from the cavernous portion of the internal carotid artery (ICA) may produce compression of the adjacent 3rd - 6th cranial nerves and result in symptoms such as headache and pain. Moreover, if the aneurysm extends into the subarachnoid space, subarachnoid hemorrhage may occur. As direct surgery to treat giant ICA aneurysms is difficult, the conventional treatment of patients manifesting tolerance upon test occlusion is ICA ligation[1]. Experience with endovascular detachable balloon embolization therapy[2,3] has shown that the positioning of detachable balloons is sometimes difficult, primarily because no adequate detachment mechanism has been devised. Therefore, detachable coils may be superior because more precise detachment is possible. We report 7 patients with giant aneurysms arising from the cavernous portion of the ICA who were successfully treated by trapping of the ICA on either side of the aneurysm using detachable coils.

Methods

Between 1995 and 1999, 7 patients with a giant ICA aneurysm were treated by ICA trapping, using detachable coils for embolization. They were one male and 6 females, ranging in age from 50 to 76 years (mean 66.1 years). Their clinical presentation included mass effect with symptoms of diplopia, retro-orbital pain and visual disturbance. All of the aneurysms were located in the cavernous portion of the ICA (table 1). Diagnostic, high-magnification cerebral angiograms and rapid-sequence digital subtraction angiograms (DSA) were obtained to assess the aneurysmal size and shape, and the relationship of the aneurysm neck to the ICA.

Then, test occlusion of the cervical ICA was carried out. Arterial back-pressure measurements were recorded and serial neurological tests were performed for 30 min during temporary carotid occlusion to insure patient tolerance. In these procedures, the contralateral in-

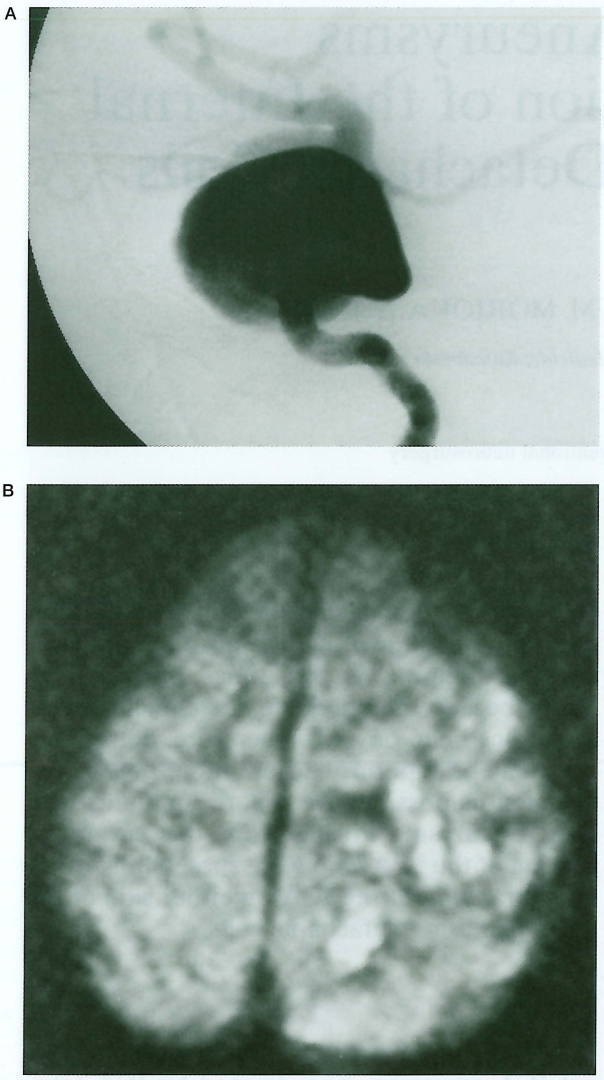

Figure 1 Case 1. A) Left internal carotid angiogram showing a giant aneurysm in the cavernous portion. B) Diffusion MRI showing multiple infarctions in the left parietal lobe after ICA ligation with coils.

ternal carotid artery, ipsilateral external carotid artery and dominant vertebral artery were studied to evaluate the collateral circulation across the circle of Willis and to detect retrograde filling of the aneurysm. When no neurological deficits were recognized, single photon emission computed tomograms (SPECT) using 99mTc-ethyl cysteinate dimer (99mTc-ECD) were obtained under re-occlusion of the ICA.

Patients with clinical evidence of profound ischemia and very low (<30mmHg) back-pressure during balloon test occlusion may require a high-flow venous bypass graft before sacrifice of the ICA. In patients with no ischemic symptoms during balloon test occlusion, SPECT study may demonstrate hypoperfusion of the hemisphere ipsilateral to the occlusion site, and these patients may require a low-flow bypass (superficial temporal artery to middle cerebral artery: STA-MCA bypass). Patients who tolerate balloon occlusion and manifest no hypoperfusion on SPECT study during ICA occlusion can be treated by sacrificing the ICA without a bypass.

We usually sacrifice the ICA using several detachable coils. If there is retrograde filling of the aneurysm from a collateral flow, we perform ICA sacrifice by trapping on both side of the aneurysmal orifice. Patients who did not receive bypass surgery underwent sacrifice of the ICA in the angiography suite following the balloon occlusion test and SPECT. Patients who required bypass surgery underwent sacrifice of the ICA in the operating room and a portable DSA instrument was available during the procedure.

Results

Six patients tolerated balloon test occlusion without clinical deficits, however, 4 patients demonstrated mild to moderate hypoperfusion on SPECT scans. One patient developed a neurological deficit (hemiparesis) on test occlusion, this rapidly resolved upon deflation of the balloon. Based on these results, 4 patients underwent an STA-MCA bypass and sacrifice of the ICA, and one patient underwent a high-flow bypass and sacrifice of the ICA. The remaining 2 patients underwent sacrifice of the ICA only. All patients were treated with anticoagulation therapy for a week and antiplatelet therapy for several months after the ICA occlusion.

One patient underwent only proximal occlusion of the ICA using detachable coils because the microcatheter could not be advanced to the distal aneurysmal orifice. On the first day after treatment, this patient had transient ischemic complications due to an embolic episode after proximal occlusion of the ICA despite anticoagulation therapy (figure 1). Therefore, she underwent direct surgery for ICA trapping between the proximal site of the ophthalmic artery and the distal orifice, using a clip, on the day after proximal occlusion of the ICA. After this procedure, her ischemic complications disappeared. All other patients underwent trapping of the ICA between the distal and proxi-

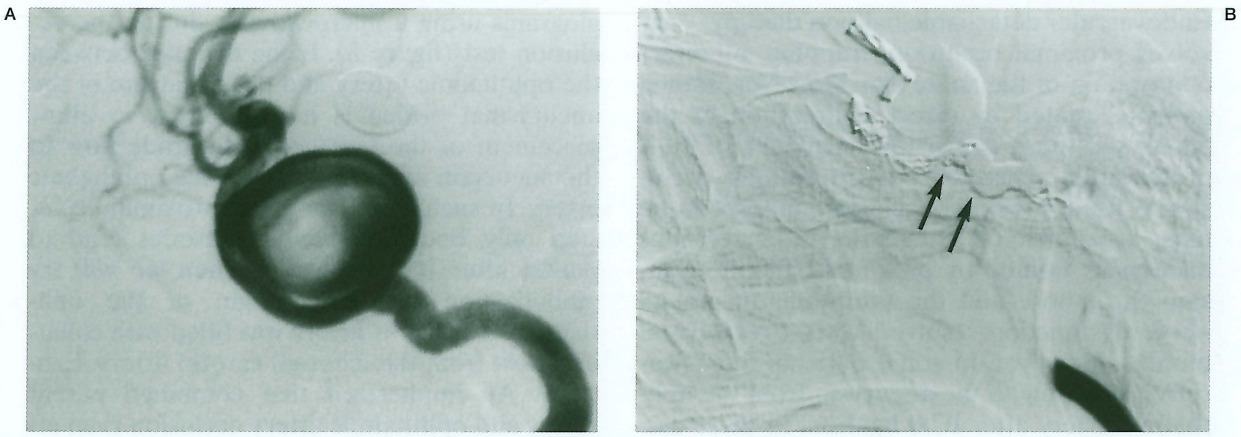

Figure 2 Case 2. A) Right internal carotid angiogram showing a giant aneurysm in the cavernous portion. B) After ICA trapping with a coil, the angiogram showed complete disappearance of the aneurysm. The distal (small arrow) and proximal (large arrow) sites of the aneurysmal orifice were completely obstructed with detachable coils. An aneurysmal clip was applied to the contralateral aneurysm arising from left IC-PC.

mal sites of the aneurysmal orifice using detachable coils (figure 2). They demonstrated significant improvement of their neurological symptoms approximately 3-6 months after treatment. All patients were followed up for a minimum of 6 months.

Discussion

In patients with giant ICA aneurysms, neurosurgical approaches are often unsuitable and the majority of reported cases were managed by carotid ligation procedures [4,5]. Ligation of the ICA has been used to treat intracranial carotid artery aneurysms with morbidity and mortality rates varying between 10 and 20% [6].

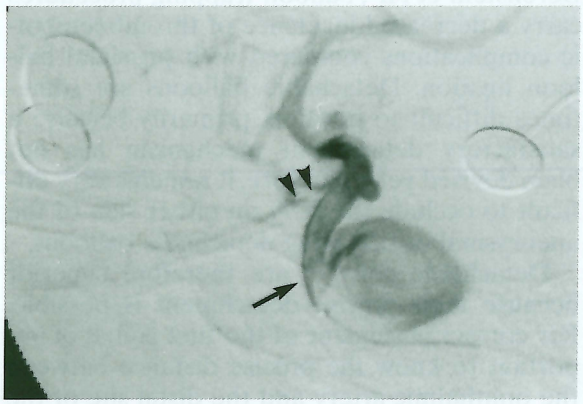

Figure 3 Superselective angiogram demonstrating the distal site of the aneurysmal orifice (small arrow) and ophthalmic artery (arrow head).

Table 1 **Summary of the seven patients of giant aneurysm of the internal carotid artery**

Case	Age/Sex	Symptom	Site	Size	BOT		Bypass	Treatment	Complication	Outcome
					Symptom	SPECT				
1	66 F	Lt.II,III,IV	Cav	28mm	none	normal	none	coil ligation	infarction (transient)	good
2	68 F	Rt.III,IV,VI	Cav	25mm	none	normal	none	coil trapping	none	good
3	50 M	Lt.VI	Cav	30mm	none	hypoperfusion	STA-MCA	coil trapping	none	good
4	63 F	Rt. III,IV,VI	Cav	26mm	none	hypoperfusion	STA-MCA	coil trapping	none	good
5	65 F	Lt.III,IV,V,VI	Cav	20mm	none	hypoperfusion	STA-MCA	coil trapping	none	good
6	75 F	Lt.III,V	Cav	27mm	none	hypoperfusion	STA-MCA	coil trapping	none	good
7	76 F	Lt. III,IV,V,VI	Cav	35mm	hemiparesis	N.D.	Vein	coil trapping	none	good

BOT = balloon occlusion test; Cav = cavernous portion of the internal carotid artery; N.D. = not done; SPECT = single photon emission computed tomography; STA-MCA = superficial temporal artery - middle cerebral artery

Endovascular detachable balloon therapy[4,7,8] involves proximal occlusion, trapping, or direct obliteration of the aneurysm. However, among patients treated by direct obliteration of the aneurysm, there was a low incidence of ICA preservation. Therefore, when balloon occlusion is used, proximal occlusion appears to be most acceptable. Most of the intracavernous aneurysms treated by proximal balloon occlusion thrombose and the symptoms of cranial nerve dysfunction resolve slowly over several months. However, in some patients there was retrograde flow to the aneurysm from the ophthalmic artery after ICA ligation. In these cases, proximal occlusion may not result in complete thrombosis of the aneurysm and there is a risk of microemboli from the intra-aneurysmal thrombus to the distal ICA. According to Berenstein et Al[9], balloon trapping procedures carry a decreased incidence of thromboembolic complications compared with proximal balloon ligation. Detachable balloons are sometimes difficult to position, primarily because a satisfactory detachment mechanism has not been devised yet. Therefore, it remains very difficult to occlude the ICA on either side of the aneurysmal orifice using detachable balloons.

Detachable coils[10,11] are therefore superior because their precise detachment is possible. For correct placement of the first coil, it is important to know the precise distance between the ophthalmic artery and the distal site of the aneurysmal orifice. Therefore, we obtained angiograms using a microcatheter during the occlusion test (figure 3). If the distance between the ophthalmic artery and the distal site of the aneurysmal orifice is not sufficient to allow placement of the first coil, retrograde flow to the aneurysm may continue via the ophthalmic artery. In such cases, we avoid proximal occlusion only, because embolic episodes tend to persist after ICA occlusion. Then we will try embolization involving origin of the ophthalmic artery if its artery was filled with collateral flow from the external carotid artery. Ezura et Al emphasized that combined parent artery and ophthalmic artery occlusion is an effective treatment for a giant aneurysm located between the ophthalmic artery and the posterior communicating artery. They used detachable balloons and coils to reduce the danger of embolic ischemia after ICA occlusion and to ensure complete thrombosis of the giant ICA aneurysm[12]. We found that detachable coils can be used successfully to occlude both the distal and proximal sites of the aneurysmal orifice of the parent ICA and that retrograde filling completely disappeared after placing a coil just proximal to the ophthalmic artery.

Conclusions

ICA trapping using detachable coils, is an effective treatment modality, particularly in patients with giant symptomatic aneurysms in the cavernous portion of the ICA.

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